

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

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1. Agency Use Only (Leave blank).

2. Report Date.
19903. Report Type and Dates Covered.
Abstract

4. Title and Subtitle.

Separation of the Mean Gulf Stream Topography From an Altimeter-Derived Reference Surface Using Genetic Algorithms

5. Funding Numbers.

Program Element No 62435N

Project No 3587

Task No.

Accession No DN256010

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Naval Oceanographic and Atmospheric Research Laboratory
Stennis Space Center, MS 39529-5004

8. Performing Organization Report Number.

AB 90:321:116

9. Sponsoring/Monitoring Agency Name(s) and Address(es).

Naval Oceanographic and Atmospheric Research Laboratory
Ocean Sciences Directorate
Stennis Space Center, MS 39529-5004

10. Sponsoring/Monitoring Agency Report Number.

AB 90:321:116

11. Supplementary Notes.

AGU

12a. Distribution/Availability Statement.

Approved for public release; distribution is unlimited.

12b. Distribution Code.

13. Abstract (Maximum 200 words).

The presence of mean dynamic topography in the reference surface used to calculate altimetric sea-surface height (SSH) residuals leads to significant difficulty in interpretation. When the "geoid" is subtracted from an individual pass the mean dynamic topography is also subtracted, leading to artifacts such as apparent "counterflow" as strong as the Gulf Stream itself. Several "synthetic geoid" methods have been developed to address this problem. One particularly simple approach involves a mathematical representation of mean and instantaneous Gulf Stream profiles. The method employs a least-squares fit to SSH residuals to determine model parameters. The modeled mean Gulf Stream is then added to the SSH residual profile to allow a better depiction of the instantaneous Gulf Stream. This method works well, but suffers from the practical difficulty that convergence is often not achieved unless the initial parameter estimates are close to the correct values. We turned to genetic algorithms (GAs) in an effort to find a more robust approach. GAs are search techniques that are based on the mechanics of natural selection. GAs apply the "generate and test" search procedure iteratively over a large set of candidate solutions. They search large numbers of candidate solutions simultaneously, and they use random search and/or selection rather than deterministic methods. GAs have been used in a number of optimization problems, but to our knowledge this is their first application to curve fitting. A number of novel variations on the basic method are necessary. The "organisms" in a GA represent solutions to the problem, in this case the values of the parameters of a model that involves the difference of two hyperbolic tangent terms. The method requires input of the ranges in which the parameters lie. More accurate results are obtained with smaller ranges, i.e., better initial estimates of the parameters. However, one can obtain*

14. Subject Terms.

(U) Remote Sensing; (U) Artificial Intelligence; (U) Lagrangian Drifter;
(U) Microbubbles

15. Number of Pages.

1

16. Price Code.

17. Security Classification of Report.
Unclassified18. Security Classification of This Page.
Unclassified19. Security Classification of Abstract.
Unclassified20. Limitation of Abstract.
SAR

AD-A229 821

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*accurate results with very little prior knowledge with some experimentation.

The GA approach to fitting this SSH model to altimeter data is easily implemented, is accurate, and provides consistent results. We show specific examples of the application of this technique to GEOSAT altimeter data SSH residuals.

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Keywords: Ocean surfaces; Height finding; Altimeters;
Artificial intelligence; Mathematical models;
Curve fittings; Least squares method;
Lagrangian functions; Algorithms. (MM) ←



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